

REMARKS/ARGUMENTS

Claims 1-14, 17, 19 and 24-32 have been resubmitted. Claims 16, 18, 22 and 23 have been amended. Claims 15, 20 and 21 have been canceled.

The Examiner has rejected claims 16, 17, 19 and 20 under 35 U.S.C. 102 (b) as being anticipated by Marey (USPN 5,964,575) and also by Albrecht et al. (USPN 5,273,396). Claim 21 has also been rejected under 35 U.S.C. 102(b) as being anticipated by Albrecht et al. Claim 27 has further been rejected under 35 U.S.C. 102(b) as being anticipated by Alford et al. U.S. Patent Application No 2003/0185674 (referred to hereinafter as 'the '674 application).

The Examiner has rejected claims 1-3 under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of Alford et al. U.S. Patent Application No 2004/0120808 (referred to hereinafter as "the '808 application") and further in view of Arilla (USPN 6,575,697). Claim 4 has also been rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of the '808 application and Arilla and further in view of Creevy et al. (USPN 5,188,506). Claims 5 and 9-10 have further been rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and the '808 application in view of Arilla and further in view of Morrison et al. (USPN 6,197,424). Claims 6 and 7 were rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and the '808 application in view of Arilla and further in view of Morrison and Knudsen et al. (USPN 3,986,720). Claim 8 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and the '808 application in view of Arilla and further in view of Morrison and Proctor et al. (USPN 5,593,276). Claims 11-14 were rejected under 35 U.S.C. 103(a) as being unpatentable over the '808 application in view of the '674 application. Claim 15 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of the '808 application, Arilla, and Albrecht. Claim 18

was rejected under 35 U.S.C. 103(a) as being unpatentable over Marey. Claim 22 was rejected under 35 U.S.C. 103(a) as being unpatentable over Albrecht and Proctor. Claims 23, 24 and 26 were rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of Creevy. Claim 25 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of Creevy and Arilla. Claims 28 and 29 were rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application in view of Creevy. Claim 30 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and the '808 application. Claim 31 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and the '808 application in view of Morrison. Claim 32 was rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application and Albrecht.

Examiner Interview

On June 28 2005, Applicant's representative requested and was granted an informal telephonic interview by the Examiner. A discussion was directed to consideration of the efficacy of filing a Declaration under 37 CFR 1.131, swearing behind two of the cited references, U.S. Patent Application No. 2004/0120808 (Alford et al.) with an effective date under 35 U.S.C. 102(e) of June 24, 2004 and U.S. Patent Application 2003/0185674 (Alford et al.) with an effective date of October 2, 2003.

While there was no commitment on the part of the Examiner, there was general concurrence that such a Declaration would be given due consideration in a reconsideration of claims which were rejected, either in whole or in part, on the basis of these references.

Marey (USPN 5,964,575)

Marey discloses a distribution device that projects cooling air onto surfaces of a stator ring at varying angles of impingement. For example, some air streams emerging from apertures (12) of Marey impinge on underlying surfaces of a stator ring (3) at oblique angles. Some of the air streams impinge at a more desirable 90° angle. But the geometry of a wall (7) in which the apertures (12) are formed does not facilitate this desirable 90° impingement from all of the apertures.

Currently amended claim 16 is now directed towards an impingement cooling array comprising holes with axes perpendicular to an outer surface of an axisymmetric plenum balloon wherein an outer surface of the axisymmetric plenum balloon follows a contour of an internal surface of a plenum so that each of the holes of the impingement array are oriented to provide flow in a direction that is perpendicular to a corresponding underlying portion of the internal surface of the plenum. A desirable 90° impingement is provided through all of the holes in an impingement array of a plenum balloon defined in currently amended claim 16. Additionally claim 16 now recites that an internal surface of a plenum comprised of enclosing surfaces of the segments and hanger rails is provided with impingement cooling.

As clearly illustrated in Figure 3 of the specification, the plenum balloon is uniquely shaped so that an outer surface of the axisymmetric plenum balloon follows a contour of an internal surface of the plenum so that each of the holes of the impingement array are oriented to provide flow in a direction that is perpendicular to a corresponding underlying portion of the internal surface of the plenum.

In contrast to the present invention, the Marey distribution system provides impingement cooling only on the stator ring (3). Stator ring supporting members are not provided with impingement cooling in Marey. Applicants

submit therefore that the inventions of currently amended claim 16 and its dependent claims 17 and 19 are not anticipated by Marey under 35 U.S.C. 102(b).

Claim 18 as currently amended defines a structure in which inlet openings are axially aligned with the flow metering openings. This axial alignment produces a desirable straightening of cooling flow as discussed in paragraph [0051] of the specification.

The distribution system of Marey does not include any structure that acts to align fluid flow into its flow metering apertures (13). Marey does not teach or suggest the flow alignment aspects of the invention of currently amended claim 18. Applicants submit therefore Marey does not establish unpatentability of claim 18 under 35 U.S.C. 103(a).

Albrecht et al. (USPN 5,273,396)

Original claims 16, 17, 19, 20 and 21 have been rejected under 35 U.S.C. 102(b) as being anticipated by Albrecht. Claims 15-17, 19-21 and 32 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Albrecht in combination with other references.

Albrecht discloses a distribution device that projects cooling air onto surfaces of shroud segment at varying angles of impingement. For example, some air streams emerging from holes (98) of Albrecht impinge on underlying surfaces of a shroud segment at oblique angles. Some of the air streams may impinge at a more desirable 90° angle. But the geometry of a cover (94B) in which the holes (98) are formed does not facilitate this desirable 90° impingement from all of the holes.

Currently amended claim 16 is now directed to an impingement cooling array comprising holes with axes perpendicular to an outer surface of an axisymmetric plenum balloon wherein an outer surface of the axisymmetric plenum balloon follows a contour of an internal surface of a plenum so that each of the holes of the impingement array are oriented to provide flow in a direction that is perpendicular to a corresponding underlying portion of the internal surface of the plenum. A desirable 90° impingement is provided through all of the holes in an impingement array of a plenum balloon defined in currently amended claim 16. Additionally claim 16 now recites that an internal surface of a plenum comprised of enclosing surfaces of the segments and hanger rails is provided with impingement cooling.

As discussed above with respect to the rejection under Marey, desirable 90° impingement is provided through all of the holes in an impingement array of a plenum balloon defined in currently amended claim 16. As clearly illustrated in Figure 3 of the specification, the plenum balloon is uniquely shaped so that an outer surface of the axisymmetric plenum balloon follows a contour of an internal surface of the plenum so that each of the holes of the impingement array are oriented to provide flow in a direction that is perpendicular to a corresponding underlying portion of the internal surface of the plenum.

In contrast to the present invention, the Albrecht distribution system provides impingement cooling only on the shroud segment. Shroud segment supporting members are not provided with impingement cooling in Albrecht. Applicants submit therefore that the inventions of currently amended claim 16 and its dependent claims 17 and 19 are not anticipated by Albrecht under 35 U.S.C. 102(b). Applicants respectfully requests withdrawal of the rejection of claims 16-19 which are based on the Albrecht reference.

Alford et al. (US Patent Application 2003/0185674)

The '674 application is cited by the Examiner as a reference that discloses a turbine shroud assembly with ceramic shroud segments (12) having a forward hook and an aft hook. The forward and aft hook engage with forward and aft hangers. A combined structure produces a plenum that is sealed to contain cooling air.

In an effort to expedite prosecution of this case, but in no way conceding to the validity of the rejections, a Declaration under 37 CFR 1.131 is filed herewith, providing proof that the inventions of claims 1, 6-8, 10-12, 27, 30 and 32 were reduced to practice prior to October 2, 2003, the publication date of the '674 application. Indeed, this reduction to practice occurred prior to the filing date of the '674 application.

One aspect of these inventions provides a method wherein ceramic shroud segments are positioned circumferentially about a longitudinal centerline axis, a forward hanger radially outward from and forward of the ceramic shroud segments, an aft hanger radially outward from and aft of the ceramic shroud segments, and a plenum assembly between and in contact with the forward and aft hanger wherein cooling air is supplied to the plenum such that air impinges on the shroud segments, the forward hanger and the aft hanger. In this regard, Applicants' method embodied those features of the '674 application which were cited by the Examiner as a basis for rejection of claim 27 under 35 U.S.C.102(e). Applicants submit that the '674 application should be withdrawn as a reference as to this claim.

Another aspect of these inventions provided shroud assemblies and methods for using shroud assemblies that embodied ceramic shroud segments having forward and aft hooks which engaged with forward and aft hanger hooks

respectively. These shroud assemblies comprised a plurality of the ceramic shroud segments assembled circumferentially about a longitudinal engine centerline axis, a plurality of ceramic spacer seals positioned in contact with the ceramic shroud segments such that each one of the ceramic spacer seals is in contact with the radially outward side of two adjacent shroud segments for the purpose of sealing adjacent segments. In this regard, Applicants shroud assemblies embodied those features of the Alford references which were cited by the Examiner as a basis for rejection of claims 1, 5-12, 30 and 32 under 35 U.S.C. 103(a). These claims have been rejected under 35 U.S.C. 103(a) as being unpatentable over the '674 application. Applicants submit that the '674 application should be withdrawn as a reference as to these claims.

Claims 9 and 31, rejected under 35 U.S.C. 103(a) define ceramic spacer seals comprised of silicon nitride ceramic. The Declaration referred to above does not describe a reduction to practice of an invention embodying silicon nitride prior to the effective date of the '674 application. Nevertheless claims 9 and 31 are dependent on claims 1 and 27 respectively. Applicants submit that, because the Declaration shows this reference to be ineffective against claims 1 and 27, it follows that the reference is ineffective against their respective dependent claims.

Claims 2-4, 13-14 and 28-29 define structures that comprise rope seals. The Declaration referred to above does not describe a reduction to practice of inventions embodying rope seals prior to the effective date of the '674 application. Nevertheless, claims 2-4 and 13-14 are dependent on claim 1 and claims 28-29 are dependent on claim 27, respectively. Applicants submit that, because the Declaration shows this reference to be ineffective against claims 1 and 27, it follows that the reference is ineffective against their respective dependent claims.

Currently amended claim 23 defines a rope seal apparatus for use between a turbine shroud and hangers comprising a first and a second compressed hybrid ceramic ropes positioned between and in contact with said turbine shroud and said hangers, such that said hangers are radially outward from said compressed hybrid ceramic rope. The first hybrid ceramic rope is adjacent the forward hanger. The second hybrid ceramic rope is adjacent the aft hanger. The second hybrid ceramic rope is compressed to a greater degree than the first hybrid ceramic rope.

The '674 application discloses bar seals (58). The disclosure of bar seals in the '674 application does not teach or suggest the novel and unobvious structure of currently amended claim 23, which structure embodies rope seals. As described in paragraph [0046] of the specification, rope seals provide for an opportunity to provide a compression on the forward seal different from a compression on the aft seal. Differing compressions allow for more cooling flow to the forward seal, where air temperature is highest. The aft seal is compressed more than the forward seal and thus provides for less cooling flow through the aft seal. The bar seals of the '674 application do not provide this desirable flow balancing. There is no teaching or suggestion in the '674 application, either alone or in combination with other references, of the differentially compressed rope seal structure of claim 23 and its dependent claims 24-26. Applicants submit therefore that the '674 application is not an effective reference under 35 U.S.C 103(a) against claims 23-26 and respectfully request withdrawal of the rejections of claims 23-26.

Alford et al. (U. S. Patent application 2004/120808)

The '808 application is cited by the Examiner as a reference that discloses a turbine shroud assembly with ceramic shroud segments and

ceramic spacer seals assembled circumferentially about a longitudinal engine centerline axis.

In an effort to expedite prosecution of this case, but in no way conceding to the validity of the rejections, a Declaration under 37 CFR 1.131 is filed herewith, providing proof that the inventions of claims 1, 6-8, and 10-12 were reduced to practice prior to June 24, 2004, the publication date of the '808 application. Indeed, this reduction to practice occurred prior to the filing date of the '808 application.

These inventions provided shroud assemblies that embodied ceramic shroud segments having forward and aft hooks which engaged with forward and aft hanger hooks respectively. These shroud assemblies comprised a plurality of the ceramic shroud segments assembled circumferentially about a longitudinal engine centerline axis, a plurality of ceramic spacer seals positioned in contact with the ceramic shroud segments such that each one of the ceramic spacer seals is in contact with the radially outward side of two adjacent shroud segments for the purpose of sealing adjacent segments. In this regard, Applicants' shroud assembly embodied those features of the '808 application which were cited by the Examiner as a basis for rejection of claims 1, 6-8 and 10-12 under 35 U.S.C. 103(a). These claims have been rejected under 35 U.S.C. 103 (a) as being unpatentable over the '808 application. Applicants submit that the '674 application should be withdrawn as a reference as to these claims.

Claims 2-4 and 13-14 define structures that comprise rope seals. The Declaration referred to above does not describe a reduction to practice of an invention embodying rope seals prior to the effective date of the '808 application. Nevertheless, claims 2-4 are dependent on claim 1 and claims 13-14 are dependent on claim 11, respectively. Applicants submit that, because

the Declaration shows this reference to be ineffective against claims 1 and 11, it follows that the reference is ineffective against their respective dependent claim 2-4 and 13-14.

Claims 5 and 9 define structures that comprise silicon nitride. The Declaration referred to above does not describe a reduction to practice of an invention embodying silicon nitride prior to the effective date of the '808 application. Nevertheless, claims 5 and 9 are dependent on claim 1. Applicants submit that, because the Declaration shows this reference to be ineffective against claims 1, it follows that the reference is ineffective against its dependent claims 5 and 9.

Applicants submit therefore that the '808 application is not an effective reference under 35 U.S.C 103(a) against claims 1-14 and respectfully request withdrawal of the rejections of claims 1-14.

Arilla (USPN 6,575,697)

Claims 1-10, 15, and 25 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over Arilla in combination with the '674 application and the '808 application as well as other references

Arilla shows an aft hanger 38 having an angled surface on a forward edge of the radially inward side, wherein a seal 55 is positioned for the purpose of reducing the leakage of shroud cooling air. The seal 55 is disclosed as a gasket seal 55. In contrast, currently amended claim 23, upon which claim 25 is dependent, defines a rope seal apparatus for use between a turbine shroud and hangers comprising a first and a second compressed hybrid ceramic ropes positioned between and in contact with said turbine shroud and said hangers,

such that said hangers are radially outward from said compressed hybrid ceramic rope. The first hybrid ceramic rope is adjacent the forward hanger. The second hybrid ceramic rope is adjacent the aft hanger. The second hybrid ceramic rope is compressed to a greater degree than the first hybrid ceramic rope.

As described in paragraph [0046] of the specification, rope seals provide for an opportunity to provide a compression on the forward seal different from a compression on the aft seal. This variable compressibility allows for more cooling flow to the forward seal, where air temperature is highest. The aft seal is compressed more than the forward seal and thus provides for less cooling flow through the aft seal. The gasket seals of Arilla do not provide this desirable flow balancing capability.

There is no teaching or suggestion in Arilla of the novel and unobvious rope seal aspect of the invention of claim 25. The disclosure of gasket seals in Arilla does not teach or suggest the efficacy of rope seals in the structures of this claim.

As to claims 1 and 5-10, there is no aspect of these claims that define a use of rope seals. It would appear therefore to be inappropriate to apply Arilla as a reference against these claims.

As discussed above, the invention of Claims 1 was reduced to practice prior to the effective date of the '674 and '808 applications. Arilla, in the absence of these references, does not teach or suggest the present inventions of claims 2-4 which are dependent on claim 1.

Applicants submit that Arilla is inapplicable as a reference against claims 1-10 and 25 and respectfully request withdrawal of rejections of these claims under 35 U.S.C. 103(a).

Creevy et al.(USPN 5,188,506)

Claim 4 has been rejected under 35 U.S.C. 103 (a) as being unpatentable over Creevy in combination with the '674 application, the '808 application and Arilla. Claims 23, 24, and 26-29 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over Creevy in combination with the '674 application. Claim 25 has been rejected under 35 U.S.C. 103 (a) as being unpatentable over Creevy in combination with the '674 application and Arilla.

Creevy discloses a hybrid rope seal employed to reduce leakage only at a forward location of a shroud assembly. Claim 23 has been amended to define a novel and unobvious aspect of the present invention. Claim 23 now defines inventive apparatus which employs multiple rope seals, one at a forward hanger and another at an aft hanger. The aft hanger seal is compressed more than the forward hanger seal. As described in paragraph [0046] of the specification, differing compression allows for more cooling flow through the forward seal, where air temperature is highest. The aft seal is compressed more than the forward seal and thus provides for less cooling flow through the aft seal. The sealing arrangement of Creevy does not provide this desirable flow balancing. There is no teaching or suggestion in Creevy of the differential compression aspect of the inventions of claim 23 and its dependent claims 24-29.

Consider now, claim 4. Claim 4 is dependent on claim 1 which, after setting aside the Arilla and '674 and '808 application references as described above, defines a novel and unobvious combination of elements. Claim 4 adds one more element, ropes seals, to this novel and unobvious combination.

Applicants submit, therefore, that citing Creevy as a reference against claim 4 is not a sufficient basis for rejection of this claim.

Applicants respectfully request withdrawal of the rejection of claims 4 and 23-29 on the basis of the Creevy reference under 35 U.S.C. 103(a).

Morrison et al. (USPN 6,197,424)

Claims 5-10 and 31 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over Morrison in combination with the '674 application and the '808 application and other references..

Morrison discloses construction of various individual turbine components from silicon nitride in only a generic sense. Morrison does not describe or disclose the novel and unobvious combination of elements and method steps which are defined in independent claims 1 and 27. Claims 5-10 are dependent on claim 1 and claim 31 is dependent on claim 27. Claims 5-10 and 31 add elements to these novel and unobvious combinations. Applicants submit, therefore, that citing Morrison as a reference against claims 5-10 and 31 is not a sufficient basis for rejection of these claims.

As discussed above, the invention of claims 1 and 27 were reduced to practice prior to the effective date of the '674 and '808 applications. Morrison, in the absence of these references, does not teach or suggest the present inventions of claim 5-10 and 31 which are dependent on claim 1 and 27 respectively.

Furthermore, claims 6-8 and 10 do not expressly define silicon nitride as a material. In that regard, Applicants' submit that it is inappropriate to cite Morrison against these claims.

Applicants submit that Morrison is inapplicable as a reference against claims 5-10 and 31 and respectfully request withdrawal of rejections of these claims under 35 U.S.C. 103(a).

Knudsen et al. (USPN 3,986,720)

Claims 6 and 7 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over Knudsen in combination with the '674 application and the '808 application and other references.

Knudsen discloses construction of various individual turbine components from nickel-based alloys only in a generic sense. Knudsen does not describe or disclose the novel and unobvious combination of elements defined in independent claim 1. As discussed above, the invention of claim 1 was reduced to practice prior to the effective date of the '674 and '808 applications. Knudsen, in the absence of these references, does not teach or suggest the present inventions of claims 6 and 7 which are dependent on claim 1.

Applicants submit that Knudsen is inapplicable as a reference against claims 6 and 7 and respectfully request withdrawal of rejections of these claims under 35 U.S.C. 103(a).

Proctor et al. (USPN 5,593,276)

Claim 8 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Proctor in combination with the '674 application and the '808 application. Claim 22 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Proctor in combination with Albrecht.

Proctor may appear to disclose slots formed in a hanger as does claim 8. But, as discussed above, the inventions of claim 1 and its dependent claim 8 were reduced to practice prior to the effective date of the '674 and '808 applications. Proctor, in the absence of these references, does not teach or suggest the present invention of claim 1. Consequently, Proctor does not teach or suggest the combination of elements defined in its dependent claim 8.

Proctor may also appear to disclose a vertical flange oriented to define a cooling air flowpath. But, Proctor does not describe or disclose any aspect of the novel and unobvious combination of elements which are defined in currently amended claim 18. As discussed above with respect to the Albrecht reference, claim 18 now defines a structure wherein a cross-sectional area of inlet openings is at least about three times a cross-sectional area of flow metering openings and wherein the inlet openings are axially aligned with the flow metering openings. Proctor does not teach or suggest the structure defined in currently amended claim 18. Claim 22 is currently amended to be dependent on claim 18. Applicants submit therefore that Proctor does not constitute a suitable reference on which to base a rejection of claim 22 under 35 U.S.C. 103(a).

The Examiner has rejected claims 16, 17, 19 and 20 and 27 under 35 U.S.C. 102. Independent claim 16 has been amended to define a unique shape for a plenum balloon which differentiates it from the cited prior art. In this regard Applicants submit that they have overcome the '102 rejection of claim 16 and its dependent claims 17 and 19. Claim 27 defines a structure that was invented prior to the effective date of the reference cited against. Applicants submit that the 37 CFR 1.131 Declaration filed herewith overcomes the '102 rejection of claim 27.

The Examiner has rejected claim 18 in this application under 35 U.S.C. 103 (a) citing Marey as a reference. Claim 18 has been amended to define a unique axial alignment of air flow passages which are not taught or suggested in Marey.

The Examiner has rejected claim 22 in this application under 35 U.S.C. 103 (a) citing Albrecht and Proctor as references. Claim 22 is dependent on currently amended claim 18 which has been amended to define axial alignment of inlet and flow metering openings.

The Examiner has rejected all other claims in this application under 35 U.S.C. 103 (a) citing a plurality of references which were combined with the '674 application and the '808 application. Applicants submit that the '674 application and the '808 application are not effective as references either singly or in combination with any other references. Applicants submit that the remaining claims in this case are allowable for the reasons described above as to each of the references.

CONCLUSION

Applicants would like to thank the Examiner for the informal interview of June 28, 2005. Pursuant to that interview a Declaration under 37 CFR 1.131 is filed herewith. This Declaration swears behind the '674 application and the '808 application references.

Reconsideration and withdrawal of the Office Action with respect to Claim 1-14, 16-19 and 22-32 is respectfully requested.

In the event the examiner wishes to discuss any aspect of this response, please contact the attorney at the telephone number identified below.

Respectfully submitted,

By:



Peter Tribulski, Reg. No. 24,747

Michael A. Shimokaji

Attorney Registration No. 32, 303

Honeywell International Inc.
Law Dept. AB2
P.O. Box 2245
Morristown, NJ 07962-9806
(310) 512-4886
Attn: Oral Caglar

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Peter Tribulski, Reg. No. 24,747

Michael A. Shimokaji, Reg. No. 32,303